# PROJECT REPORT

|  |  |
| --- | --- |
| PROJECT NAME | GAS LEAKAGE MONITORING & ALERTING SYSTEM FOR INDUSTRIES |
| TEAM ID | PNT2022TMID00378 |
| TEAM MEMBERS | SWEETY.R  RAMYA.K  SOMASHREE.U  SHAMNI GAYATHRI.D |
| BRANCH | ELECTRONICS AND COMMUNICATION ENGINEERING |

**CONTENTS**

# INTRODUCTION

* 1. Overview
  2. Purpose

# LITERATURE SURVEY

* 1. Existing problem
  2. Problem statement

# IDEATION AND PROPOSED SOLUTION

* 1. Empathy Map Canvas
  2. Ideation and Brain Storming
  3. Proposed Solution

1. 4.Problem Solution Fit

# THEORITICAL ANALYSIS

* 1. Block Diagram
  2. Functional requirement
  3. Non Functional requirement

# PROJECT DESIGN

* 1. Data Flow Diagrams
  2. Solution and Technical Architecture

# PROJECT PLANNING AND SCHEDULING

* 1. Sprint Planning & Estimation
  2. Sprint Delivery Schedule

# CODING & SOLUTIONING (Explain the features added in the project along with code)

* 1. Feature 1
  2. Feature 2
  3. Database Schema (if Applicable)

# TESTING

* 1. Test Cases
  2. User Acceptance Testing

# RESULTS

* 1. Performance Metrics

# ADVANTAGES/DISADVANTAGES

1. **APPLICATIONS**

# CONCLUSION

1. **FUTURE SCOPE**

# GITHUB and DEMO LINK

1. **INTRODUCTION**

# Project Overview:

The internet of Things is a developing topic of technical, social, and economic significance. The usage of the gas brings great problems in the domestic as well as working places. The inflammable gas, which is excessively used in the work places (Industries). The leakage of the gas causes destructible impact to the lives and as well as to the heritage of the people. Most of the societies have fire safety mechanism. But it can use after the fire exists. As a result, a system for detecting and monitoring gas leaks is required. Through a flame sensor, the system will sense fire and flame. The buzzer begins to ring when a fire is detected. Tests have shown that the system can keep track of the wastage of gas and leaks and notify the user. The performance that was produced showed that it was successful in reducing the amount of gas that was wasted.

# Purpose:

The design of a sensor-based automatic gas leakage detector with an alert and control system has been proposed. This is an affordable, less power using, lightweight, portable, safe, user friendly, efficient, multi featured and simple system device for detecting gas. To monitor this gas leak, the system includes an MQ6 gas detector. This sensor detects the amount of leaking gas present in the surrounding atmosphere. In this way, the consequences of an explosion or gas leak can be avoided.

# LITERATURE SURVEY :

* 1. **Existing Problem:**

Gas leakage is nothing but the leak of any gaseous molecule from a pipeline, or cylinder etc in the industries. Gas Leakages in open or closed areas can prove to be dangerous .This can occur either purposefully or even unintendedly. As we are aware that these kinds of leaks are dangerous to our health, and when it becomes explosive it could cause great danger to the people, industry and the environment. Therefore, we have used IoT technology to make a Gas Leakage Detector for society which has Smart Alerting techniques involving sending a text message to the concerned authority and the ability to perform data analytics on sensor readings. Our main aim is to propose a gas leakage system for a society where each flat has gas leakage detector hardware. This will detect the harmful gases in the environment and alerting to society members through the alarm and sending notifications.

# References:

* + 1. Shital Imade, Priyanka Rajmanes, Aishwarya Gavali , Prof. V. N. Nayakwadi “GAS

LEAKAGE DETECTION AND SMART ALERTING SYSTEM USING IOT”

<https://www.pramanaresearch.org/gallery/22.%20feb%20ijirs%20-%20d539.pdf>

* + 1. Kumar Keshamoni and Sabbani Hemanth. "Smart Gas Level Monitoring, Booking & Gas Leakage Detector over IoT " International Advance Computing Conference IEEE, 2017.
    2. Petros Spachos , Liang Song and Dimitrios Hatzinakos. "Gas Leak Detection and Localization System Through Wireless Sensor Networks" The 11th Annual IEEE Consumer Communications and Networking Conference - Demos. IEEE, 2014.
    3. “Design and Implementation of an Economic Gas Leakage Detector” National Institute of Health (2004). What you need to know about natural gas detectors.

Availa[ble:htt](http://www.nidcd.nih.gov/health/smelltaste/gas)p:/[/www.nidcd.nih.gov/health/sm](http://www.nidcd.nih.gov/health/smelltaste/gas)e[lltaste/gas](http://www.nidcd.nih.gov/health/smelltaste/gas) dtctr.asp.

* + 1. Prof.M.Amsaveni, A.Anurupa, R.S.Anu Preetha, C.Malarvizhi,M.Gunasekaran “Gsm based LPG leakage detection and controlling system” the International Journal of Engineering and Science (IJES) ISSN (e): 2319 – 1813 ISSN (p):2319 – 1805 Pages 112116 March- 2015.
    2. Srinivasan,Leela,Jeyabharathi,Kirthika,Rajasree“GAS LEAKAGE DETECTION AND CONTROL” Scientific Journal of Impact Factor(SJIF): 3.134.
    3. Pal-Stefan Murvaya, IoanSileaa “A survey on gas leak detection and localization techniques”.
    4. Ch. Manohar Raju, N. Sushma Rani, “An android based automatic gas detection and indication robot. In International Journal of Computer Engineering and Applications. 2014;8(1).
    5. Falohun A.S., Oke A.O., Abolaji B.M. “Dangerous Gas Detection using an Integrated Circuit and MQ-9” in International Journal of Computer Applications (0975 –8887) Volume 135 – No.7, February 2016.
    6. Ashish Shrivastava,Ratnesh Prabhaker, Rajeev Kumar and Rahul Verma “GSM BASED GAS LEAKAGE DETECTION SYSTEM” in International Journal of Technical Research and Applications e-ISSN: 2320- [8163,ww](http://www.ijtra.com/)w.ijt[ra.com](http://www.ijtra.com/) Volume 1, Issue 2 (mayJune 2013).

# Problem Statement Definition:

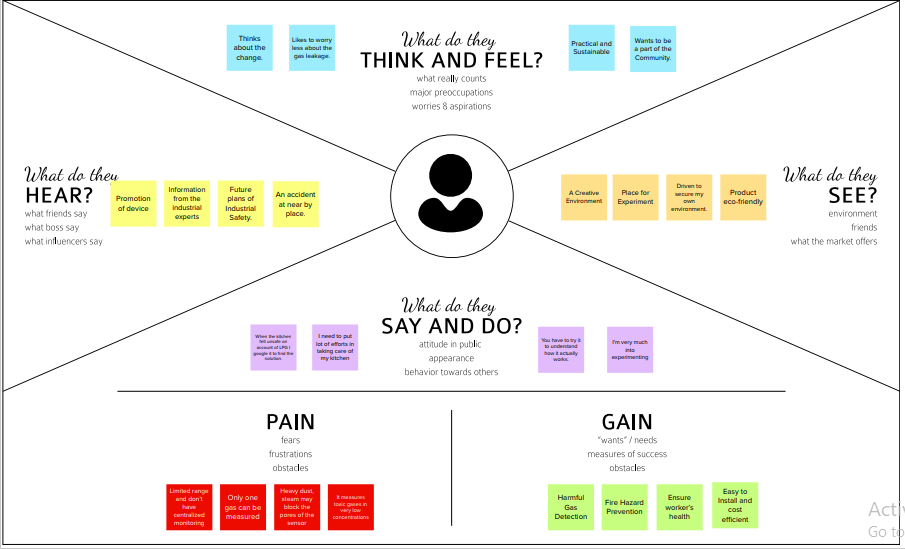
In most industries, one of the key parts of any safety plan for reducing risks to personnel and plant is the use of early-warning devices such as gas detectors. These can help to provide more time in which to take remedial or protective action. They can also be used as part of a total, integrated monitoring and safety system for an industrial plant. Rapid expansion of oil and gas industry leads to gas leakage incidents which are very serious and dangerous. Solutions need to be found out at least to minimize the effects of these incidents since gas leaks also produce a significant financial loss. The challenges are not only to design a prototype of the device that can only detect but also automatically respond to it whenever the leakage occurs.

Customer Problem Statement:

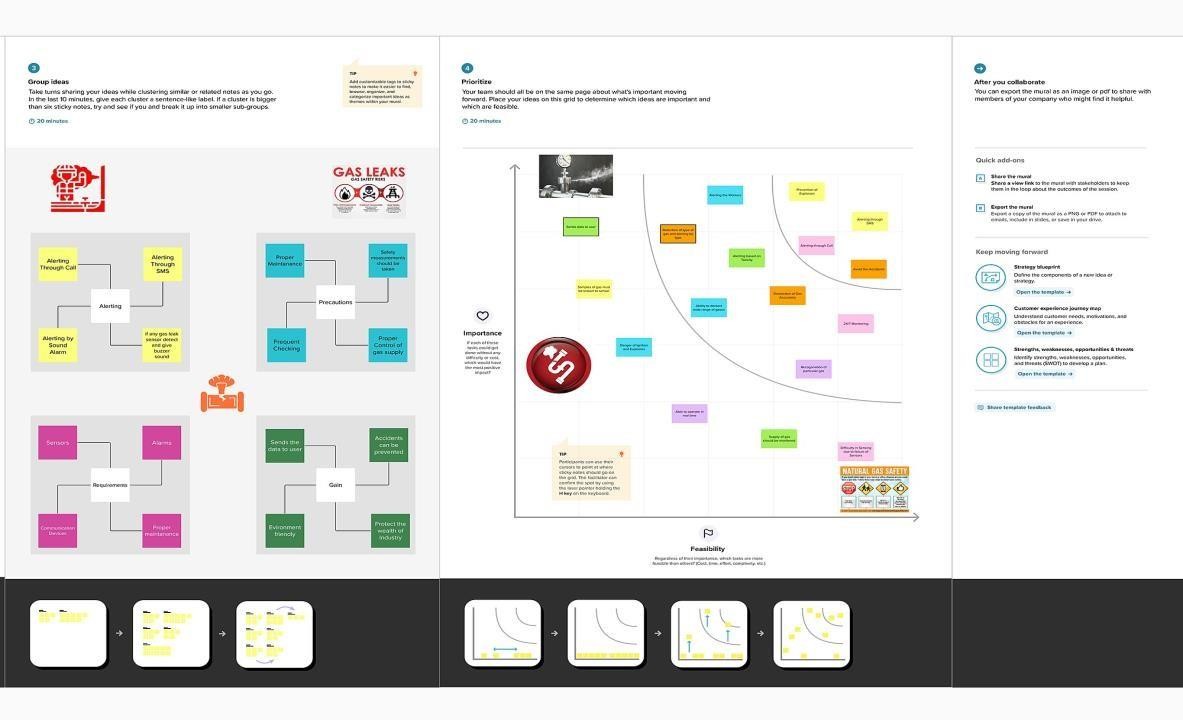


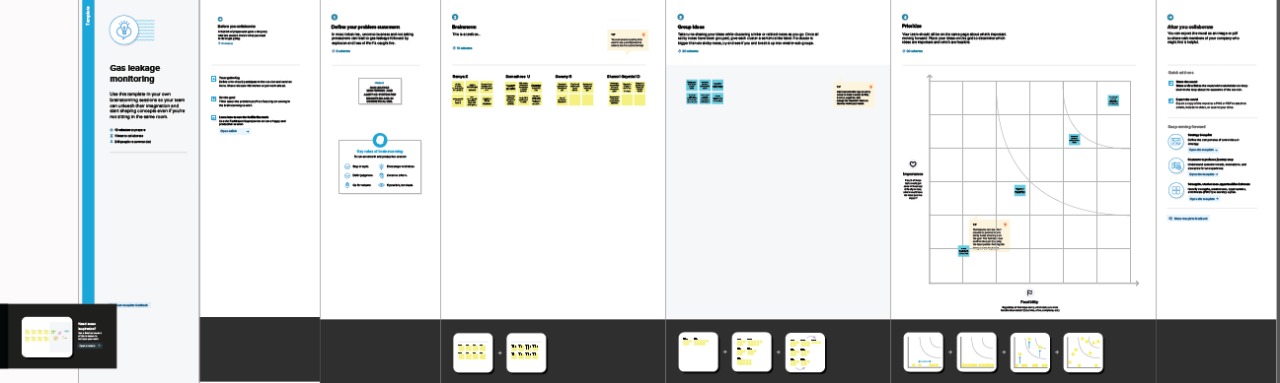
# IDEATION & PROPOSED SOLUTION:

* 1. **Empathy Map Canvas:**



# Ideation & Brainstorming:



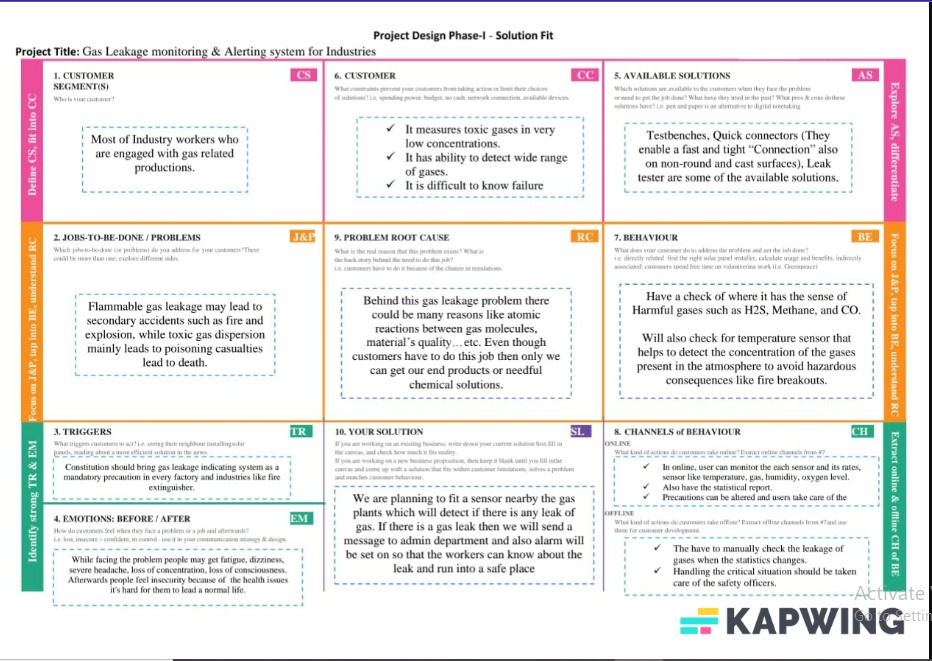


* 1. **Proposed Solution:**

PROPOSED SOLUTION TEMPLATE:

|  |  |  |
| --- | --- | --- |
| S.NO | PARAMETER | DESCRIPTION |
| 1. | PROBLEM STATEMENT  (Problem to be solved) | Gas leakage is one of the major issues in industries. The leakage of a gas leads to major fire accidents which lead to heavy damage inside the industry and also to the workers in the industry as well as the loss of human beings .It is feasible to detect the gas leakage before any disaster happened. So industries need a very efficient gas leakage monitoring and detection system. The aim of this paper is to propose an industrial safety system for workers working in these types of polymer industries by automatically detect, alert and control gas leakage ,fire and smoke using IOT based system. |
| 2. | IDEA /SOLUTION DESCRIPTION | In order to overcome the leakage problem ,the proposed solution consist of an gas sensor integrated to monitor .If gas leakage is detected in any area the admins will be notified along with the location, and the admins can view the sensor parameters through the web application. |
| 3. | NOVELTY | Even though there are many solutions for this problem they failed to satisfy the needs of the customers or workers .Some of the solutions detect and alert only to the main department related to the industry and other solutions are with defects. Our proposed solution not only notifies the industry person but also notify the fire fighters so that can take control over the situation and our solution will also alert the workers even there is a small leakage of gas. |
| 4. | SOCIAL IMPACT/CUSTOMER SATISFACTION | The benefit of a gas detection and alerting system is that it will provide the customer or worker with 24/7 monitoring, and it can watch all areas. Even if you have a section left unmanned the majority of the time, it still can monitor to warn your personnel of a hazardous environment before entering. Through this proposed solution the workers lives can be saved. |
| 5. | BUSINESS MODEL(Revenue model) | The aim target of our solution is industries so we have planned to visit industries and explain them about the benefits of our products .so that they can aware of the importance of this solution and use it. |
| 6. | SCALABILITY OF THE SOLUTION | Our solution can be integrated for further future use because the solution we have provided with be lay on the basic or initial stage of any upgraded version |

# Problem Solution fit:



1. **REQUIREMENT ANALYSIS:**

# Functional requirement:

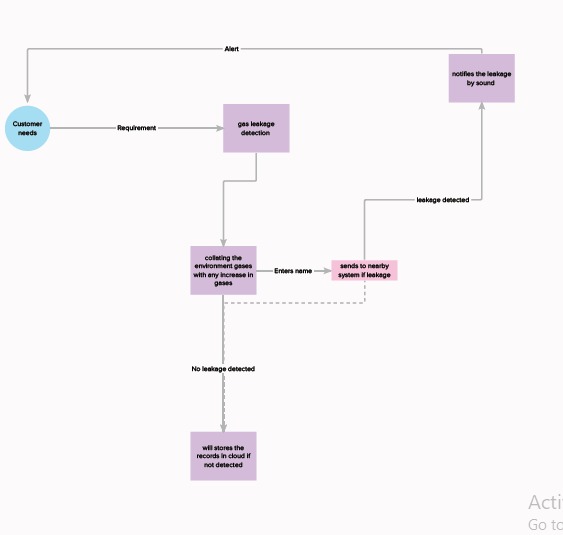
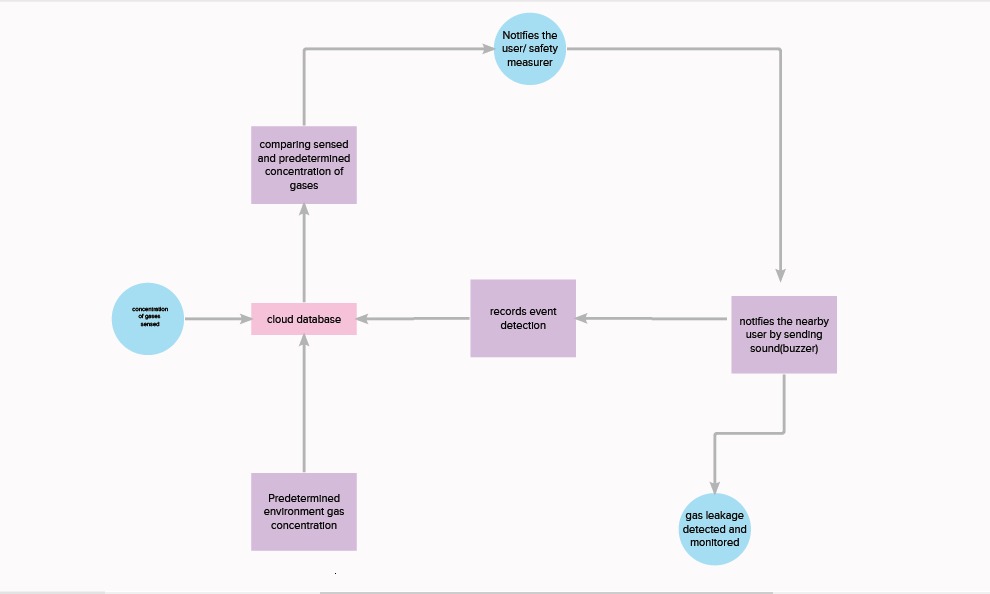
|  |  |  |
| --- | --- | --- |
| **FR**  **No.** | **Functional Requirement**  **(Epic)** | **Sub Requirement (Story / Sub-Task)** |
| FR-1 | Leakage | Installation of Gas sensors at specified intervals. |
| FR-2 | Notification | When rule condition is met, notification triggered using  MQTT. |
| FR-3 | Geo coordinates of nodes | 1. Predefined set of GPS locations of nodes is obtained. 2. When notification is triggered, Geo coordinates of the node is also sent along |
| FR-4 | IoT Platform | IBM Watson IoT Platform |
| FR-5 | Cloud Services | IBM Cloud Database |
| FR-6 | Programming tool | NODE-RED Services |

* 1. **Non-Functional requirements:**

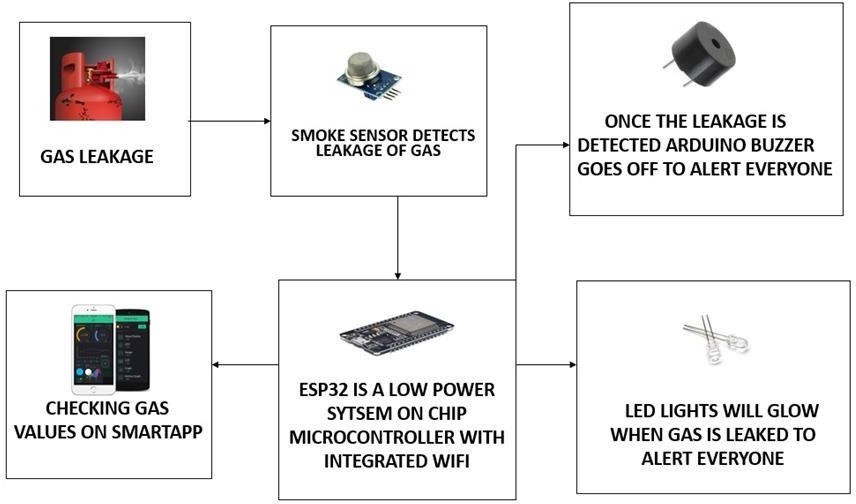
|  |  |  |
| --- | --- | --- |
| **FR**  **No.** | **Non-Functional**  **Requirement** | **Description** |
| NFR-  1 | **Usability** | Easy user interface with alerting notifications and location of the  defect gas cylinder. |
| NFR- 2 | **Security** | 1. Secure Cloud database is used. 2. Notify only the registered and verified users. 3. Multiple deployments across the potential sources can help industries to avoid any industrial accident and protect workplace safely. |
| NFR- 3 | **Reliability** | 1. Gas exposure will measured with ± 25% of the true concentration of the target analyte with 95% certainty. 2. Robust device that can withstand harsh industrial conditions and provide real-time gas leakage detection. |
| NFR-  4 | **Performance** | 1. Accurate data monitoring system enables periodic analysis of the  air quality. |
|  |  | 2. Provides data on a real-time basis which enables safety managers  to take timely corrective actions |
| NFR-  5 | **Availability** | 1. Through Suppliers. 2. With online shopping platforms. |
| NFR- 6 | **Scalability** | 1. Can be extended further from industrial application to domestic gas applications. 2. Deployment in petrol banks and vehicle fuel plants for gas leakage detection application. |

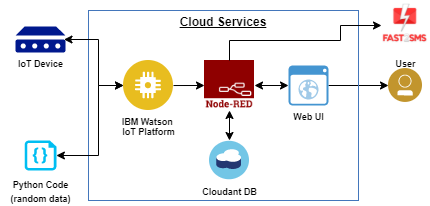
# PROJECT DESIGN:

* 1. **Data Flow Diagrams:**

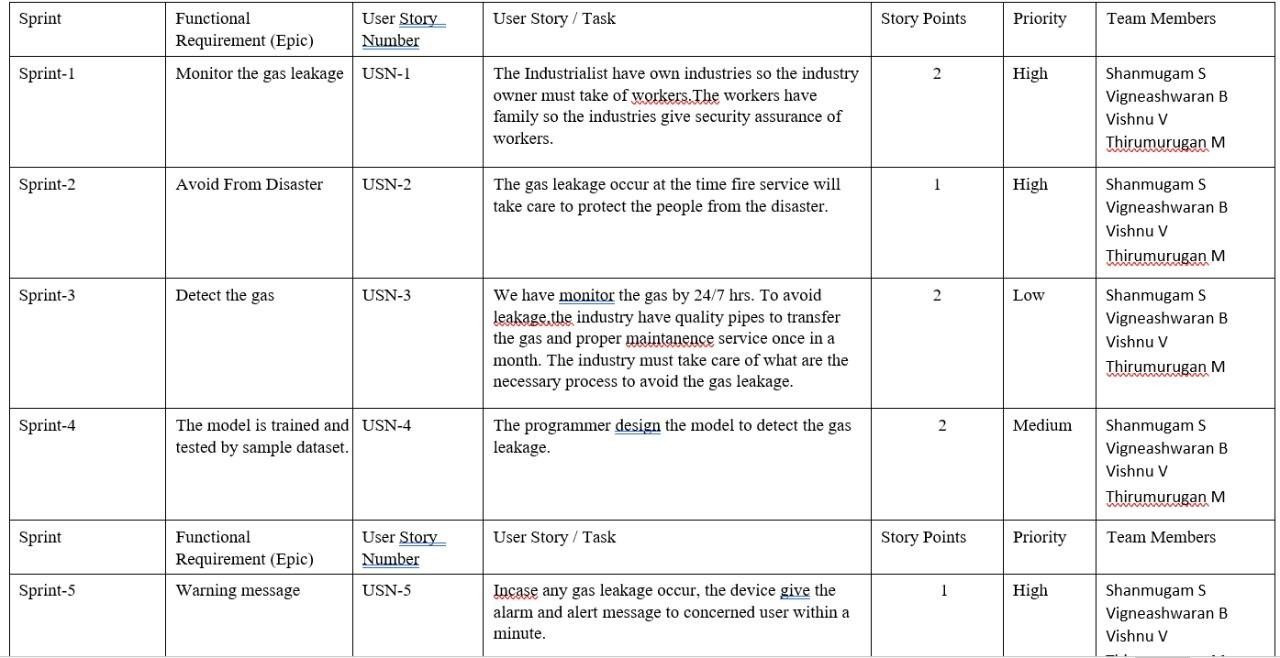


# Solution & Technical Architecture:





* 1. **User Stories:**



# PROJECT PLANNING & SCHEDULING:

* 1. **Sprint Planning & Estimation:**
* SPRINT PLAN
* ANALYZE THE PROBLEM
* PREPARE an ABSTRACT, PROBLEM STATEMENT
* LIST A REQUIRED OBJECT NEEDED
* CREATE A PROGRAM CODE AND RUN IT
* MAKE A PROTOTYPE TO IMPLEMENT
* TEST WITH THE CREATED CODE AND CHECK THE DESIGNED PROTOTYPE

# Sprint Delivery Schedule:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sprint | Functional  Requirement (Epic) | User Story | User Story / Task | Story Point | Priority |
| Sprint-1 | Create | US-1 | Create the IBM Cloud services which are being used in this project. | 5 | High |
| Sprint-1 | Configure | US-2 | Configure the IBM Cloud services which are being used in completing this project. | 1 | Medium |
| Sprint-1 | Create | US-3 | IBM Watson IoT platform acts as the mediator to connect the web application to IoT devices, so create the IBM Watson IoT platform. | 1 | Medium |

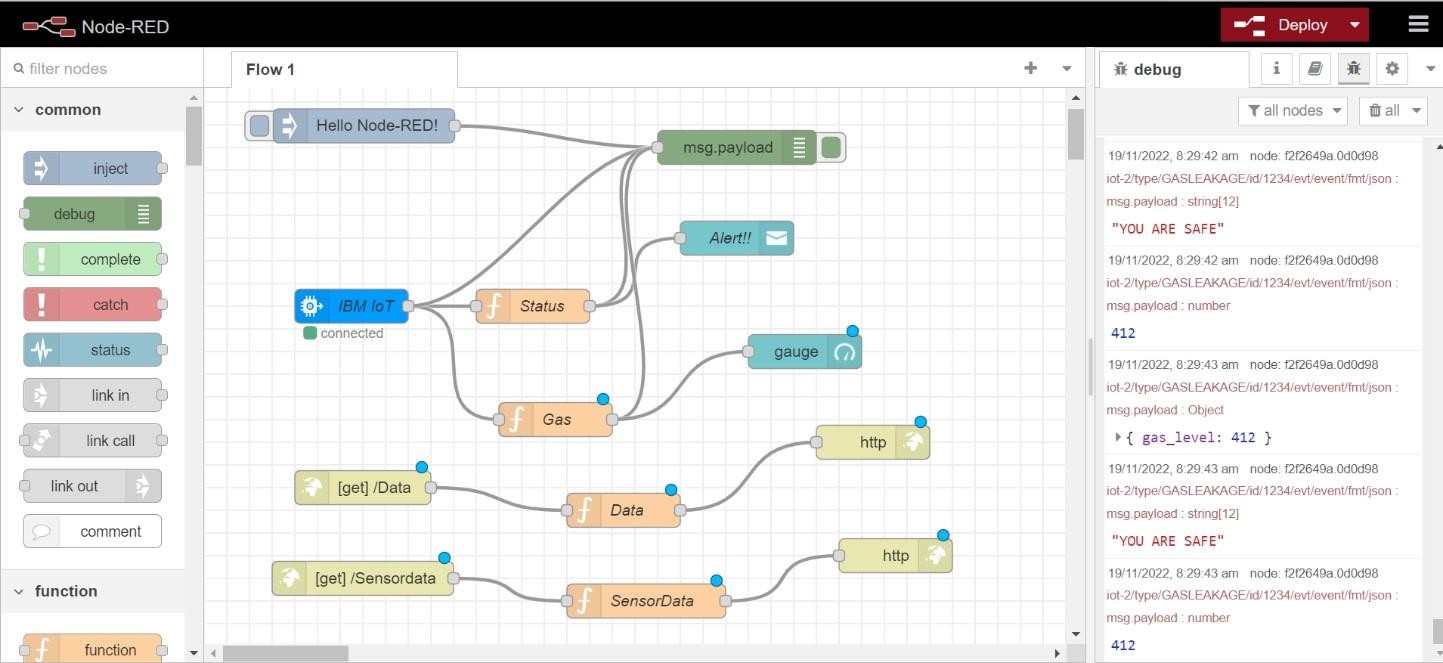
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sprint-1 | Configure | US-4 | Configure the IBM Watson IoT which are being used to display the output. | 13 | High |
| Sprint-2 | Create | US-1 | In order to connect the IoT device to the IBM cloud, create a device in the IBM Watson IoT platform and get the device credentials. | 13 | High |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sprint-2 | Configure | US-2 | Configure a device in the IBM Watson IoT platform and get the device credentials. | 3 | Medium |
| Sprint-2 | Create | US-3 | Create a Node-RED service. | 3 | High |
| Sprint-2 | Configure | US-4 | Configure the connection security and create API keys that are used in the  Node- RED service for accessing the  IBM IoT Platform. | 1 | Medium |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sprint-3 | Develop | US-1 | Develop a python script to publish  random sensor data such as temperature,  Flame  level and Gas level to the IBM  IoTplatform | 1 3 | High |
| Sprint-3 | Configure | US-2 | After developing python code and commands just run  the code | 1 | Medium |
| Sprint-3 | Print | US-3 | Print the statements which represent the control of the devices. | 1 | Low |
| Sprint-3 | Publish | US-4 | Publish Data to  The IBM Cloud | 5 | High |
| Sprint-4 | Create | US-1 | Create Web UI in Node- Red | 5 | High |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sprint-4 | Configure | US-2 | Configure the Node-  RED flow to receive data from the IBMIoT platform | 5 | High |
| Sprint-4 | Configure | US-3 | Use cloudant DB nodes to store the received sensor data in the cloudant DB | 5 | High |
| Sprint-4 | Publish | US-4 | Publish the received data in webapplication | 5 | High |

**NODE RED WORKING**



# CODING & SOLUTIONING:

# Importing Required modules import time import

sys

import wiotp.sdk.device# IBM IoT Watson Platform Module import ibmiotf.device import tkinter as tk # Python GUI Package from tkinter import ttk # Python GUI import time from threading import Thread

organization = "9s9m43" # Organization ID deviceType = "NodeMCU" # Device type deviceId = "gasleakage" # Device ID authMethod = "token" # Authentication Method authToken = "1234589123" #Replace the authtoken

# Tkinter root window root = tk.Tk() root.geometry('350x300') # Set size of root window root.resizable(False, False) # root window non- resizable root.title('Gas Leakage Monitoring And Alerting System for Industries (PNT2022TMID00378)')

# Layout Configurations root.columnconfigure(0, weight=1) root.columnconfigure(1, weight=3)

current\_gas = tk.DoubleVar()

def get\_current\_gas(): # function returns current gas level value return '{: .2f}'.format(current\_gas.get())

def slider\_changed(event): # Event Handler for changes in sliders print('------

--')

print('Gas Level: {: .2f}'.format(current\_gas.get())) print('------

--')

gas\_label.configure(text=str(get\_current\_gas()) +" ppm") # Displays current gas level as label content

# Tkinter Labels

# label for the gas level slider slider\_gas\_label = ttk.Label(root,text='Set Gas Level:') slider\_gas\_label.grid(column=0,row=0,sticky='w')

# Gas Level slider slider\_gas

=

ttk.Scale(root,from\_=0,to=3000,orient='horizontal', command=slider\_changed,variable=current\_ gas)

slider\_gas.grid(column=1,row=0,sticky='we')

# current gas level label

current\_gas\_label = ttk.Label(root,text='Current Gas Level:') current\_gas\_label.grid(row=1,columnspan=2,sticky='n',ipadx=10,ipady=10)

# Gas level label (value gets displayed here)

gas\_label = ttk.Label(root,text=str(get\_current\_gas()) +" ppm") gas\_label.grid(row=2,columnspan=2,sticky='n')

def publisher\_thread(): thread = Thread(target=publish\_data)

thread.start()

def publish\_data(): # Exception Handling try: deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method": authMethod,

"auth-token": authToken} deviceCli = ibmiotf.device.Client(deviceOptions)

# ..............................................

except Exception as e: print("Caught exception connecting device: %s" % str(e)) sys.exit()

deviceCli.connect() # Connect to IBM Watson IoT Platform while True: gas\_level =

int(current\_gas.get())

data = {'gas\_level' : gas\_level}

def myOnPublishCallback(): print("Published Gas Level = %s ppm" % gas\_level, "to IBM Watson")

success = deviceCli.publishEvent("event", "json", data, qos=0, on\_publish=myOnPublishCallback)

if not success: print("Not connected to IoTF")

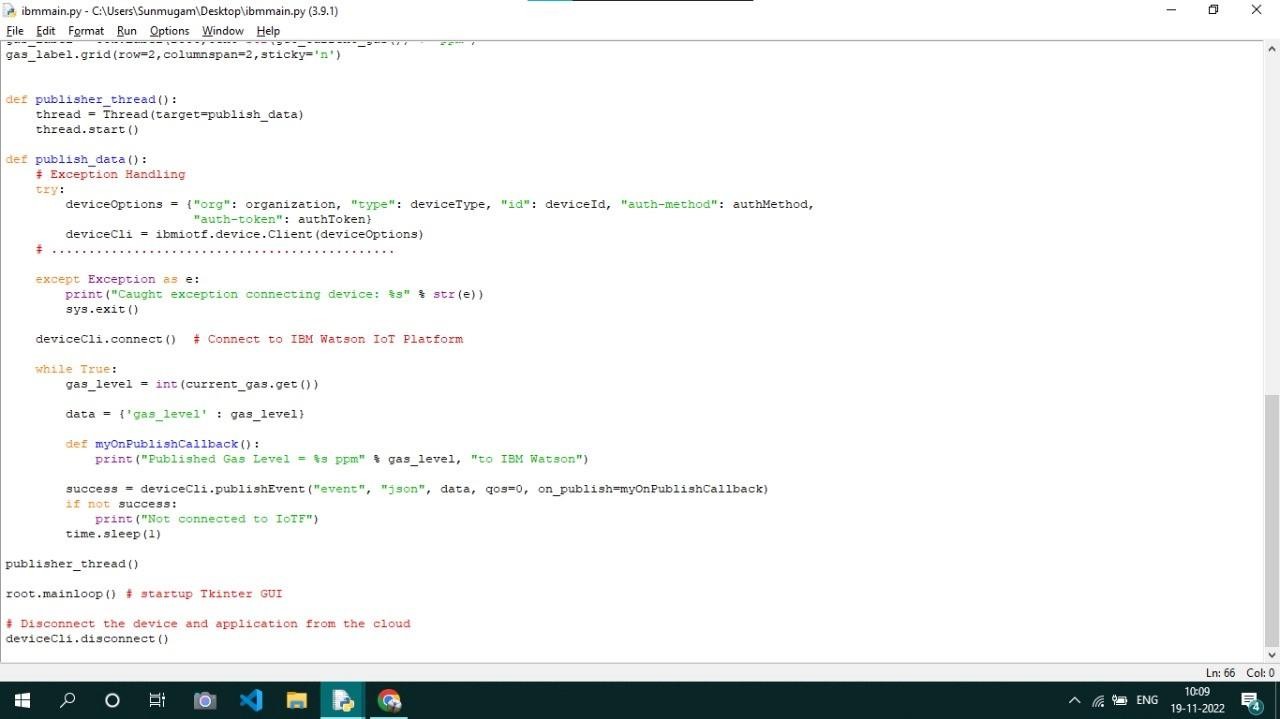
time.sleep(1) publisher\_thread()

root.mainloop() # startup Tkinter GUI

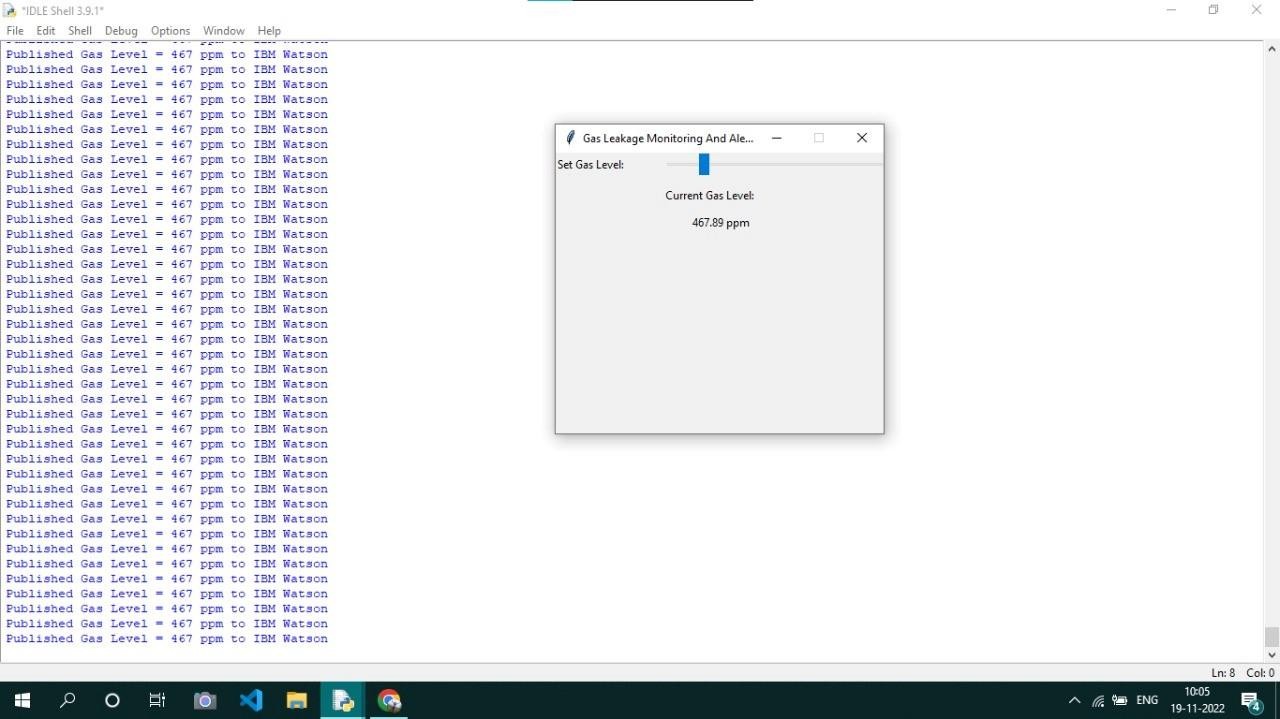
# Disconnect the device and application from the cloud deviceCli.disconnect()

# CODE:

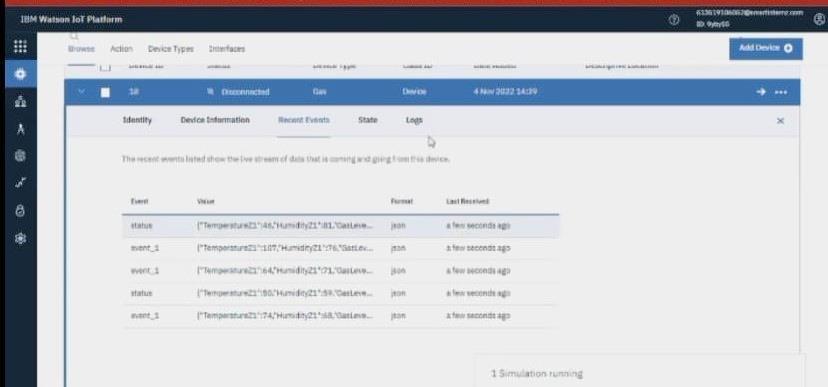




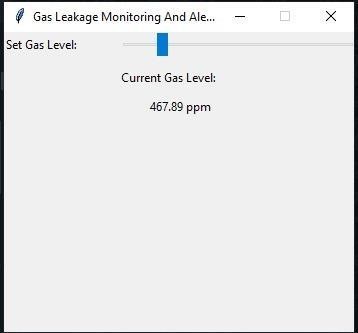
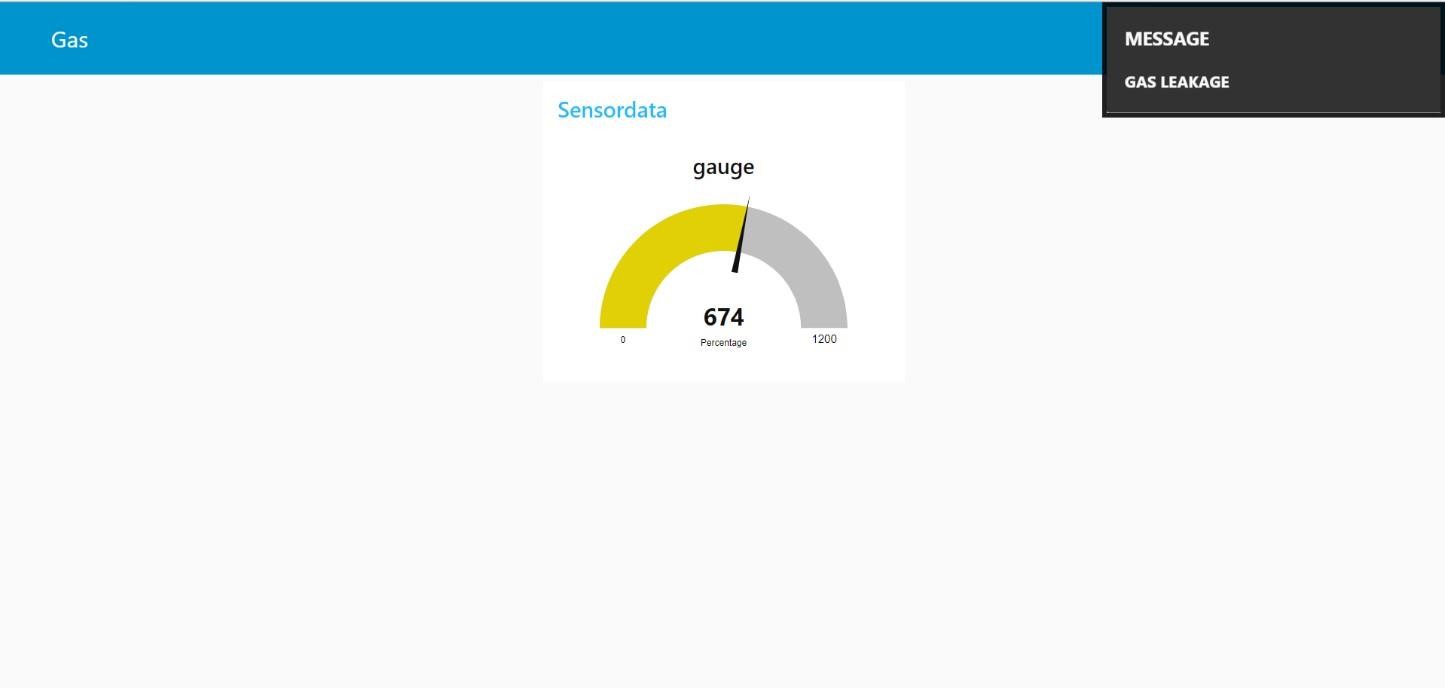
**OUTPUT:**

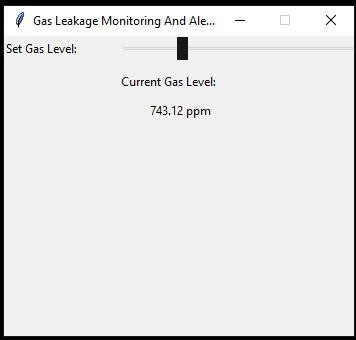


**8. TESTING**

****

****





**UAT TESTING**



# Test Case Analysis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Exception Reporting | 9 | 0 | 0 | 9 |
| Final Report Output | 4 | 0 | 0 | 4 |
| Version Control | 2 | 0 | 0 | 2 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

1. **Result:**

The system can be taken as a small attempt in connecting the existing primary gas detection methods to a mobile platform integrated with IoT platforms. The gases are sensed in an area of 1m radius of the rover and the sensor output data are continuously transferred to the local server. The accuracy of sensors is not up to the mark thus stray gases are also detected which creates an amount of error in the outputs of the sensors, especially in case of methane. Further the availability and storage of toxic gases like hydrogen sulphide also creates problems for testing the assembled hardware. As the system operates outside the pipeline, the complication of system maintenance and material selection of the system in case of corrosive gases is reduced. Thus, the system at this stage can only be use data primary indicator of leakage inside a plant.

# Advantages/Disadvantages:

* 1. **Advantages:**

1. Get real-time alerts about the gaseous presence in the atmosphere.
2. Prevent fire hazards and explosions.
3. Supervise gas concentration levels.
4. Ensure worker’s health.
5. Real-time updates about leakages.
6. Cost-effective installation.
7. Data analytics for improved decisions.
8. Measure oxygen level accuracy.
9. Get immediate gas leak alerts.

# Disadvantages:

1. It requires air or oxygen to work.
2. It gets reacted due to heating of wire.
3. It can be poisoned by lead, chlorine and silicon

# CONCLUSION:

This gas leak detector system contains two features, this includes the SMS Gateway feature for only sending warning information regarding the gas leak to user, and the alarm for the warning alert. There is some improvement which can be applied for the future work, such as regarding the SMS Gateway, it need to enhance with feature such as notifying the user whenever the remaining credit balance is insufficient. Another thing which can be enhanced is regarding the sensor, the sensors in this module do not include somewhat notification for notifying the user whenever the sensor not working properly or not connected to the micro-controller for some cases, therefore, it is recommended to add this kind of features in the future work for better refinement.

# FUTURE SCOPE:

We propose to build the system using an MQ6 gas detection sensor and interface it with an Aurdino Uno microcontroller along with an LCD Display. This system uses the gas sensor to detect any gas leakages. The gas sensor sends out a signal to the microcontroller as soon as it encounters a gas leakage. The microcontroller processes this signal and a message is displayed on the LCD to alert the user.

# GITHUB:

**Link :** [**https://github.com/IBM-EPBL/IBM-Project-12061-1659368763**](https://github.com/IBM-EPBL/IBM-Project-12061-1659368763)

# Demo Link : <https://drive.google.com/file/d/146OH_vr6TOPn0yBm1Y7U9WMwIVYs8ie-/view?usp=drivesdk>